Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Claim 1 (Canceled).

2.   (Currently amended) A method of evaluating tolerances of computer assisted designs for the manufacture of objects comprising, for each object:

representing each tolerance zone for each geometric feature of said object by a model with an algebraic form and a geometric form, wherein the geometric form is represented as a tolerance map stored in a computer. ~~The method of claim 1~~ where representing each tolerance zone for each geometric feature of said object comprises creating a tolerance map in three dimensions representing a plane:

computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other;

determining how different tolerance zones for geometric features on different objects affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects.

3.   (Currently amended) <u>A method of evaluating tolerances of computer assisted</u> <u>designs for the manufacture of objects comprising, for each object:</u>

<u>representing each tolerance zone for each geometric feature of said object by a model</u> <u>with an algebraic form and a geometric form, wherein the geometric form is represented as a</u> <u>tolerance map stored in a computer,</u> ~~The method of claim 1~~ where representing each tolerance zone for each geometric feature of said object further comprises creating a tolerance map in four dimensions representing a line, axis or edge<u>;</u>

<u>computing in said computer interdependencies between said stored maps and</u> <u>interdependencies between submaps of said stored maps, wherein submaps correspond to</u> <u>subzones of tolerance zones, to determine how different tolerance zones for said geometric</u> <u>feature affect each other and to determine how different tolerance zones for different geometric</u> <u>features of said object affect each other;</u>

<u>determining how different tolerance zones for geometric features on different objects</u> <u>affect each other; and</u>

<u>selecting tolerance conditions for said object to optimize allocation of tolerances to each</u> <u>of said geometric features of said object or objects.</u>

4.   (Currently amended) <u>A method of evaluating tolerances of computer assisted</u> <u>designs for the manufacture of objects comprising, for each object:</u>

<u>representing each tolerance zone for each geometric feature of said object by a model</u> <u>with an algebraic form and a geometric form, wherein the geometric form is represented as a</u> <u>tolerance map stored in a computer,</u> ~~The method of claim 1~~ where representing each tolerance zone for each geometric feature of said object further comprises creating a tolerance map in five

dimensions representing the tolerances for each cylindrical surface, including tolerance on size

and the tolerance-zone for the position of the axis of the cylindrical surface;

computing in said computer interdependencies between said stored maps and

interdependencies between submaps of said stored maps, wherein submaps correspond to

subzones of tolerance zones, to determine how different tolerance zones for said geometric

feature affect each other and to determine how different tolerance zones for different geometric

features of said object affect each other;

determining how different tolerance zones for geometric features on different objects

affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each

of said geometric features of said object or objects.

5.   (Currently amended) A method of evaluating tolerances of computer assisted

designs for the manufacture of objects comprising, for each object:

representing each tolerance zone for each geometric feature of said object by a model

with an algebraic form and a geometric form, wherein the geometric form is represented as a

tolerance map stored in a computer, ~~The method of claim 1~~ where representing each tolerance

zone for each geometric feature of said object comprises creating a tolerance map representing a

position;

computing in said computer interdependencies between said stored maps and

interdependencies between submaps of said stored maps, wherein submaps correspond to

subzones of tolerance zones, to determine how different tolerance zones for said geometric

feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other;

determining how different tolerance zones for geometric features on different objects affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects.

6. (Currently amended) A method of evaluating tolerances of computer assisted designs for the manufacture of objects comprising, for each object:

representing each tolerance zone for each geometric feature of said object by a model with an algebraic form and a geometric form, wherein the geometric form is represented as a tolerance map stored in a computer, ~~The method of claim 1~~ where representing each tolerance zone for each geometric feature of said object or objects, comprises a tolerance map representing composite tolerances constructed as a Minkowski sum;

computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other;

determining how different tolerance zones for geometric features on different objects affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects.

5

7.   (Currently amended) <u>A method of evaluating tolerances of computer assisted</u>

<u>designs for the manufacture of objects comprising, for each object:</u>

<u>representing each tolerance zone for each geometric feature of said object by a model</u>

<u>with an algebraic form and a geometric form, wherein the geometric form is represented as a</u>

<u>tolerance map stored in a computer,</u> ~~The method of claim 1~~ where representing each tolerance

zone for each geometric feature of said object comprises a tolerance map in a space of points of

variational possibilities of features of said object<u>;</u>

<u>computing in said computer interdependencies between said stored maps and</u>

<u>interdependencies between submaps of said stored maps, wherein submaps correspond to</u>

<u>subzones of tolerance zones, to determine how different tolerance zones for said geometric</u>

<u>feature affect each other and to determine how different tolerance zones for different geometric</u>

<u>features of said object affect each other;</u>

<u>determining how different tolerance zones for geometric features on different objects</u>

<u>affect each other; and</u>

<u>selecting tolerance conditions for said object to optimize allocation of tolerances to each</u>

<u>of said geometric features of said object or objects.</u>

8.   (Currently amended) <u>A method of evaluating tolerances of computer assisted</u>

<u>designs for the manufacture of objects comprising, for each object:</u>

<u>representing each tolerance zone for each geometric feature of said object by a model</u>

<u>with an algebraic form and a geometric form, wherein the geometric form is represented as a</u>

<u>tolerance map stored in a computer</u> ~~The method of claim 1~~ where representing each tolerance

zone for each geometric feature, or combination of geometric features, of said object comprises creating a tolerance map in a space of points that represent the variational possibilities of manufacture for the features of said object;

computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other;

determining how different tolerance zones for geometric features on different objects affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects.

9.   (Currently amended) A method of evaluating tolerances of computer assisted designs for the manufacture of objects comprising, for each object:

representing each tolerance zone for each geometric feature of said object by a model with an algebraic form and a geometric form, wherein the geometric form is represented as a tolerance map stored in a computer, The method of claim 1 where representing each tolerance zone for each geometric feature, or cluster of geometric features, of said object comprises creating a tolerance map in a space of points that represent the variational possibilities of manufacture for the features of said object expressed in areal (barycentric) coordinates;

computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to

7

subzones of tolerance zones, to determine how different tolerance zones for said geometric

feature affect each other and to determine how different tolerance zones for different geometric

features of said object affect each other;

determining how different tolerance zones for geometric features on different objects

affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each

of said geometric features of said object or objects.

10.   (Currently amended) A method of evaluating tolerances of computer assisted

designs for the manufacture of objects comprising, for each object:

representing each tolerance zone for each geometric feature of said object by a model

with an algebraic form and a geometric form, wherein the geometric form is represented as a

tolerance map stored in a computer;

computing in said computer interdependencies between said stored maps and

interdependencies between submaps of said stored maps, wherein submaps correspond to

subzones of tolerance zones, to determine how different tolerance zones for said geometric

feature affect each other and to determine how different tolerance zones for different geometric

features of said object affect each other, ~~The method of claim 1~~ where computing in said

computer interdependencies between said stored maps and interdependencies between submaps

of said stored maps comprises superimposing on a tolerance zone of said geometric feature an

orientation tolerance zone which more stringently controls the orientational variations including

parallelism, angularity and perpendicularity, from the nominal condition of said geometric

feature;

determining how different tolerance zones for geometric features on different objects affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects.

11.   (Currently amended) A method of evaluating tolerances of computer assisted designs for the manufacture of objects comprising, for each object:

representing each tolerance zone for each geometric feature of said object by a model with an algebraic form and a geometric form, wherein the geometric form is represented as a tolerance map stored in a computer;

computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other. The method of claim 1 where computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps comprises superimposing on a tolerance zone of said geometric feature a tolerance zone specifying form including flatness, straightness and cylindricity of said geometric feature;

determining how different tolerance zones for geometric features on different objects affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects.

12.   (Currently amended) A method of evaluating tolerances of computer assisted designs for the manufacture of objects comprising, for each object:

representing each tolerance zone for each geometric feature of said object by a model with an algebraic form and a geometric form, wherein the geometric form is represented as a tolerance map stored in a computer;

computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other. ~~The method of claim 1~~ where computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps comprises generating a tolerance zone of an assembled geometric feature for a assembly of at least two objects, each of which objects has a corresponding tolerance zone for corresponding geometric features which are being assembled to comprise said assembled geometric feature;

determining how different tolerance zones for geometric features on different objects affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects.

Claims 13-15 (Canceled).

16. (Currently amended) <u>A method of evaluating tolerances of computer assisted designs for the manufacture of objects comprising, for each object:</u>

<u>representing each tolerance zone for each geometric feature of said object by a model with an algebraic form and a geometric form, wherein the geometric form is represented as a tolerance map stored in a computer;</u>

<u>computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other;</u>

<u>determining how different tolerance zones for geometric features on different objects affect each other;</u>

<u>selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects; and</u>

~~The method of claim 1 further comprising~~ establishing a global model by mapping surfaces used as datum or targets in a dimensioning scheme to equivalent control frames in which datum reference frames are rigid sets and validated using degree of freedom algebraic operations, and by representing dimensions and tolerances by the union of corresponding control frames involving the datum and target rigid sets and corresponding tolerance classes.

17. (Original) The method of claim 16 wherein mapping surfaces used as datum or targets in a dimensioning scheme to equivalent control frames comprises forming datum reference frames as rigid sets for target features and feature patterns.

18.   (Original) The method of claim 17 wherein mapping surfaces used as datum or targets in a dimensioning scheme to equivalent control frames in which datum reference frames are formed as rigid sets for a circular pattern of bolt holes.

19.   (Original) The method of claim 16 further comprising identifying redundant or conflicting restraints by using a degree of freedom algebra on control frames by determining whether the corresponding datum reference frame is a rigid set and the maximum degrees of freedom which said datum reference frame controls.

20.   (Canceled).

21.   (Currently amended) A method of evaluating tolerances of computer assisted designs for the manufacture of objects comprising, for each object:

representing each tolerance zone for each geometric feature of said object by a model with an algebraic form and a geometric form, wherein the geometric form is represented as a tolerance map stored in a computer ~~The method of claim 1~~ where representing each tolerance for each geometric feature further includes representing tolerances for each tab or slot feature by generating a tolerance map in four dimensions that represents each feature, including the tolerance on feature size and the tolerance-zone for feature mid-plane;

computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric

feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other;

determining how different tolerance zones for geometric features on different objects affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects.

22. (Currently amended) A method of evaluating tolerances of computer assisted designs for the manufacture of objects comprising, for each object:

representing each tolerance zone for each geometric feature of said object by a model with an algebraic form and a geometric form, wherein the geometric form is represented as a tolerance map stored in a computer;

computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other;

determining how different tolerance zones for geometric features on different objects affect each other;

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects, and

~~The method of claim 1 further including~~ representing a symmetry tolerance zone for features including a tab, slot, or cylinder, having two tolerances on size and the symmetry for

13

relative position of feature mid-planes and/or axes, by creating a tolerance map in five dimensions to represent the symmetry of the tab or slot feature, or in six dimensions to represent the symmetry of the cylinder feature.

23. (Currently amended) <u>A method of evaluating tolerances of computer assisted designs for the manufacture of objects comprising, for each object:</u>

<u>representing each tolerance zone for each geometric feature of said object by a model with an algebraic form and a geometric form, wherein the geometric form is represented as a tolerance map stored in a computer;</u>

<u>computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other;</u>

<u>determining how different tolerance zones for geometric features on different objects affect each other;</u>

<u>selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects, and</u>

~~The method of claim 1 where further including~~ representing the tolerances for a cluster of features including a point and a line, or a plane and a line, by creating a tolerance map of a dimension higher than the dimensions of a tolerance map for either feature individually, but lower than the sum of the individual dimensions of a tolerance map for either feature.

Claim 24 (Canceled).

25.   (Currently amended) <u>A method of evaluating tolerances of computer assisted</u>

<u>designs for the manufacture of objects comprising, for each object:</u>

<u>representing each tolerance zone for each geometric feature of said object by a model</u>

<u>with an algebraic form and a geometric form, wherein the geometric form is represented as a</u>

<u>tolerance map stored in a computer</u> ~~The method of claim 1~~ where representing each tolerance

zone for each geometric feature of said object comprises creating combinations of said maps to

represent the interaction between tolerances applied to each geometric feature<u>;</u>

<u>computing in said computer interdependencies between said stored maps and</u>

<u>interdependencies between submaps of said stored maps, wherein submaps correspond to</u>

<u>subzones of tolerance zones, to determine how different tolerance zones for said geometric</u>

<u>feature affect each other and to determine how different tolerance zones for different geometric</u>

<u>features of said object affect each other;</u>

<u>determining how different tolerance zones for geometric features on different objects</u>

<u>affect each other; and</u>

<u>selecting tolerance conditions for said object to optimize allocation of tolerances to each</u>

<u>of said geometric features of said object or objects.</u>

26.   (Currently amended) <u>A method of evaluating tolerances of computer assisted</u>

<u>designs for the manufacture of objects comprising, for each object:</u>

<u>representing each tolerance zone for each geometric feature of said object by a model with an</u>

<u>algebraic form and a geometric form, wherein the geometric form is represented as a tolerance</u>

<u>map stored in a computer,</u> ~~The method of claim 1~~ where representing each tolerance zone for

each geometric feature of each object comprises creating combinations of said maps to represent the accumulation of tolerances in the geometric features of the objects in stack-up analysis;

computing in said computer interdependencies between said stored maps and interdependencies between submaps of said stored maps, wherein submaps correspond to subzones of tolerance zones, to determine how different tolerance zones for said geometric feature affect each other and to determine how different tolerance zones for different geometric features of said object affect each other;

determining how different tolerance zones for geometric features on different objects affect each other; and

selecting tolerance conditions for said object to optimize allocation of tolerances to each of said geometric features of said object or objects.

27.   (Previously presented) The method of claim 16 further comprising validating if the proper degrees of freedom of a feature are controlled by a datum reference frame, by using the global model to analyze the degrees of freedom controlled progressively to determine which degrees of freedom are controlled collectively by all datums in the datum reference frame and to determine which individual datum controls each degree of freedom to analyze the effect of datum precedence.

28.   (Previously presented) The method of claim 16 further comprising using the global model for tolerance refinement by controlling the same degree of freedom by more than one degree of freedom for selective finer controls on certain degrees of freedom.